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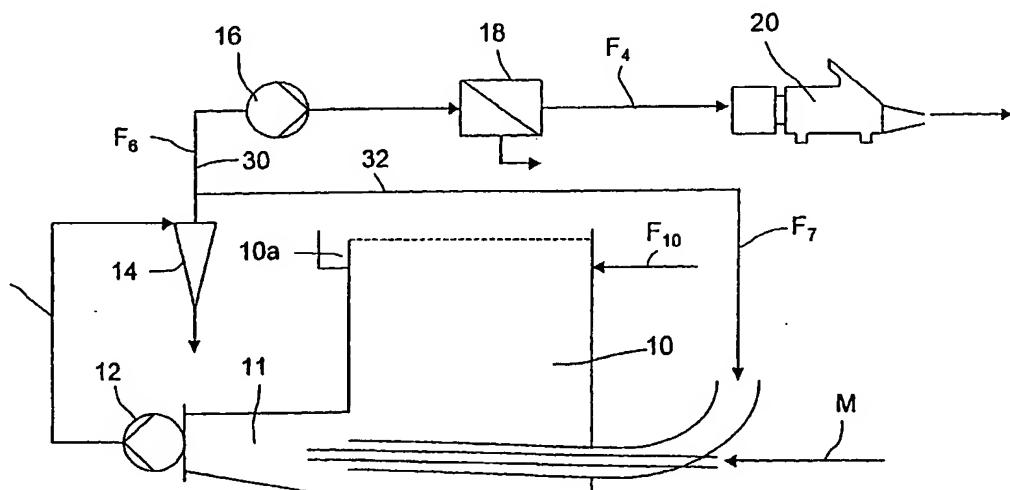
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND PROCESS ARRANGEMENT IN THE SHORT CIRCULATION OF A PAPER MACHINE



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(57) Abstract: A process arrangement in the short circulation of a paper machine comprises devices (10-13) for dilution of thick stock, centrifugal cleaners (14), and a headbox fan pump (16), as well as a pipe system connecting these. There is a direct flow connection from the centrifugal cleaners (14) along a pipeline (30) to the headbox fan pump (16), through which pipeline (30) a centrifugally cleaned stock flow (F<sub>6</sub>) is passed direct to the headbox fan pump (16) without any deaeration or dilution stages in between. A secondary line (32) is connected to the pipeline (30) for passing through it part of the centrifugally cleaned stock flow (F<sub>10</sub>) as a return flow (F<sub>7</sub>) back to the thick stock dilution devices (10-13). By this arrangement it can be ensured that the pressure on the suction side of the fan pump (16) remains substantially constant.

Method and process arrangement in the  
short circulation of a paper machine

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The invention relates to a process arrangement in the short circulation of a paper machine comprising devices for dilution of thick stock, centrifugal cleaners, and a headbox fan pump, as well as a pipe system connecting these.

- 10 The invention also relates to a method in the short circulation of a paper machine for keeping the pressure constant on the suction side of a headbox fan pump, in which method the stock is diluted to headbox consistency, cleaned by centrifugal cleaners and pumped through a headbox to a wire section of the paper machine.
- 15 In the short circulation of the paper machine, the feeding of the stock into the headbox is preceded by stages in which the thick stock is diluted to headbox consistency either in one stage or in two stages and different sorts of debris are removed in a centrifugal cleaning, deaeration and/or screening stage. From the standpoint of the stability of the entire papermaking process and its freedom from disturbance, it is important that the pressure on the suction side of the headbox fan pump can be kept constant. If the pressure is not constant, the flow quantity produced by the fan pump varies causing pressure changes in the slice jet of the headbox, which are seen as basis weight variation in the web.
- 20
- 25 The deaeration tank is generally provided with an overflow or with liquid-level control, in which connection its function is not only to remove air from the system but also to ensure that the pressure is even on the suction side of the headbox fan pump. Arrangements are also known in which there is no deaeration tank in the main line. When, for example, in the short circulation of a paper or board machine
- 30 including a centrifugal cleaning stage it has been desirable to omit a deaeration tank from the main line of the stock, the arrangement has generally comprised a

double-diluted system. In that connection, the thick stock is diluted first to a consistency required by centrifugal cleaning and the final dilution to headbox consistency is carried out only after centrifugal cleaners. The dilutions are accomplished by passing the thick stock into a wire water flow which is at a back-

5 pressure which has been made constant. By this means it can be assured at the same time that the pressure on the suction side of the headbox fan pump remains constant. However, double-dilution cannot be used when paper grades requiring a high headbox consistency are manufactured, such as SC paper, LWC paper, and newsprint.

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An object of the invention is to solve in a new way the problem of keeping the pressure constant on the suction side of the headbox fan pump. The aim is to find an alternative arrangement for the double-dilution of the stock and for the deaeration tank of the main line which have been traditionally used for this

15 purpose.

The process arrangement according to the invention is characterized by the disclosure in the characterizing part of claim 1. Similarly, the method according to the invention is characterized by the disclosure in the characterizing part of claim

20 6.

In the short circulation in accordance with the invention, on the accept side of the centrifugal cleaning stage, a pipeline is arranged which leads direct to the headbox fan pump without any deaeration and/or dilution stages usually provided in

25 between. A secondary line is connected to this pipeline between centrifugal cleaners and the fan pump for passing through it part of the stock flow coming from the accept side of the centrifugal cleaners as a return flow back to dilution devices of the thick stock such that the return flow enters the suction side of a mixing pump centrally and parallel to a dilution flow. The return location has

30 been selected so to avoid disturbances. The purpose of the secondary line is to reduce flow and pressure variations of the accept side of the centrifugal cleaning.

If it is desirable to raise the pressure on the suction side of the headbox fan pump, a valve can be used in the secondary flow. The valve is, however, not absolutely necessary.

- 5 The process arrangement in accordance with the invention is simple and the number of tanks and devices needed in it is smaller than that of conventional arrangements. The arrangement also reduces in neutral processes the precipitation of calcium compounds in the headbox approach pipe system, which results from the fact that, when calcium carbonate used as a filler is passed into a deaerator,
- 10 part of the carbon dioxide contained in the carbonate is released. When air is removed already from wire water, the distance to the approach pipe system is longer and the filler flow through the deaerator is smaller.

In the following, the invention will be described with reference to the figures in

- 15 the appended drawings, but the invention is not meant to be solely confined to the details of the figures.

Figure 1 is a schematic view of part of the conventional short circulation of a paper machine.

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Figure 2 is a schematic view of the process arrangement in accordance with the invention.

Figure 3 shows a variant of the process arrangement of Fig. 2.

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Fig. 1 is a simplified illustration of part of the short circulation of a paper machine and, in particular, a conventional headbox approach system. Thick fresh stock M is passed to a mixing area 11 of a wire pit 10, where it is diluted with wire water to a consistency required by centrifugal cleaning, which consistency in this case is

- 30 almost the same as the consistency of the stock to be fed to the headbox. A diluted stock flow F<sub>1</sub> is passed through a mixing pump 12 to centrifugal cleaners 14, in

which heavy debris like sand is removed from the stock. A cleaned stock flow  $F_2$  is passed to a deaeration tank 15, in which there is an air space with underpressure above the free surface of the stock. A stock flow  $F_3$  is passed from the lower part of the deaeration tank 15 to the suction side of a headbox fan pump 16 and 5 therefrom further to machine screens 18. A stock flow  $F_4$  is passed from the accept side of the machine screens 18 to a headbox 20, which supplies the stock to a wire section of the paper machine (not shown). Wire water  $F_{10}$  recovered from the wire section is passed to the wire pit 10 for use in the dilution of the thick stock M.

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The liquid level in the deaeration tank 15 is kept constant by means of an overflow 15a, which is passed as a return flow  $F_5$  into connection with the wire pit 10 for use in the dilution of the thick stock M. The wire pit 10 also comprises an overflow 10a. The wire pit 10 provided with the liquid-level control 10a keeps the 15 pressure constant on the suction side of the mixing pump 12 and, similarly, the deaeration tank 15 provided with the liquid-level control 15a keeps the pressure constant on the suction side of the fan pump 16.

Fig. 2 shows the short circulation of a paper machine in accordance with the 20 invention, which short circulation is provided with centrifugal cleaning and single dilution and does not comprise any deaeration tank at all in the main line. Thick stock M is diluted in the lower part of a wire pit 10 and a diluted stock flow  $F_1$  is pumped by a mixing pump 12 to centrifugal cleaners 14. The bulk of the accept from the first stage of the centrifugal cleaners 14 is passed as a stock flow  $F_6$  25 along a pipeline 30 direct to a headbox fan pump 16, which pumps it further to machine screens 18. An accept flow  $F_4$  from the first stage of the machine screens 18 is passed after that to a headbox 20 and further to a wire section of the paper machine.

30 A secondary line 32 is arranged in the pipeline 30 leading from the accept side of the centrifugal cleaners 14 to the fan pump 16, through which secondary line part

of the accept stock is passed as a return flow  $F_7$  into connection with the wire pit 10 for use in the dilution of the thick stock M. Because of the free by-pass circulation, the pressure remains constant in the pipeline 30 on the suction side of the fan pump 16. It is also possible to introduce other process flows smaller than 5 that of the main line into the secondary line 32 (not shown in the figure).

The arrangement of Fig. 3 is mainly similar to that of Fig. 2, for also in it a diluted stock flow  $F_1$  is pumped through centrifugal cleaners 14 to a fan pump 16, which pumps a stock flow  $F_6$  further through machine screens 18 to a headbox 20, and 10 part of the centrifugally cleaned stock is passed as a return flow  $F_7$  through a secondary line 32 back for the dilution of the stock. The arrangement differs from that of Fig. 2 in that the thick stock M is diluted without a wire pit in a closed mixing volume 13 as so-called pipe dilution. The thick stock M, wire water  $F_{10}$  and the return flow  $F_7$  of the centrifugally cleaned stock are passed to the mixing 15 volume 13 situated on the suction side of the fan pump 12 as parallel flows such that the incoming thick stock flow M is surrounded by the return flow  $F_7$  of diluted stock and the wire water flow  $F_{10}$  is furthest outside. The use of pipe dilution reduces further the tank and flow volume needed in the short circulation.

20 By means of the arrangement shown in Figs. 2 and 3, an even pressure can be assured on the suction side of the fan pump 16, thereby improving the stability of the system and its freedom from disturbances. The pressure control of the headbox 20 can be improved at the same time by arranging common pressure control, i.e. feedforward control, for the mixing pump 12 and the headbox fan 25 pump 16 to control the operating speed. In it, both parts of the process are controlled simultaneously and in the same direction, thus making it possible to predict situations of change better than before.

The process arrangement in accordance with the invention is particularly suitable 30 for paper or board machines of the kind in which centrifugal cleaning is needed but double dilution cannot be used because of a high headbox consistency and, for

reasons of process technology and economy, it is not desirable to use deaeration of the stock. The method is also suitable for use in multi-layer web forming, in which stock suspensions intended for different stock layers are treated separately before forming a multi-layer web.

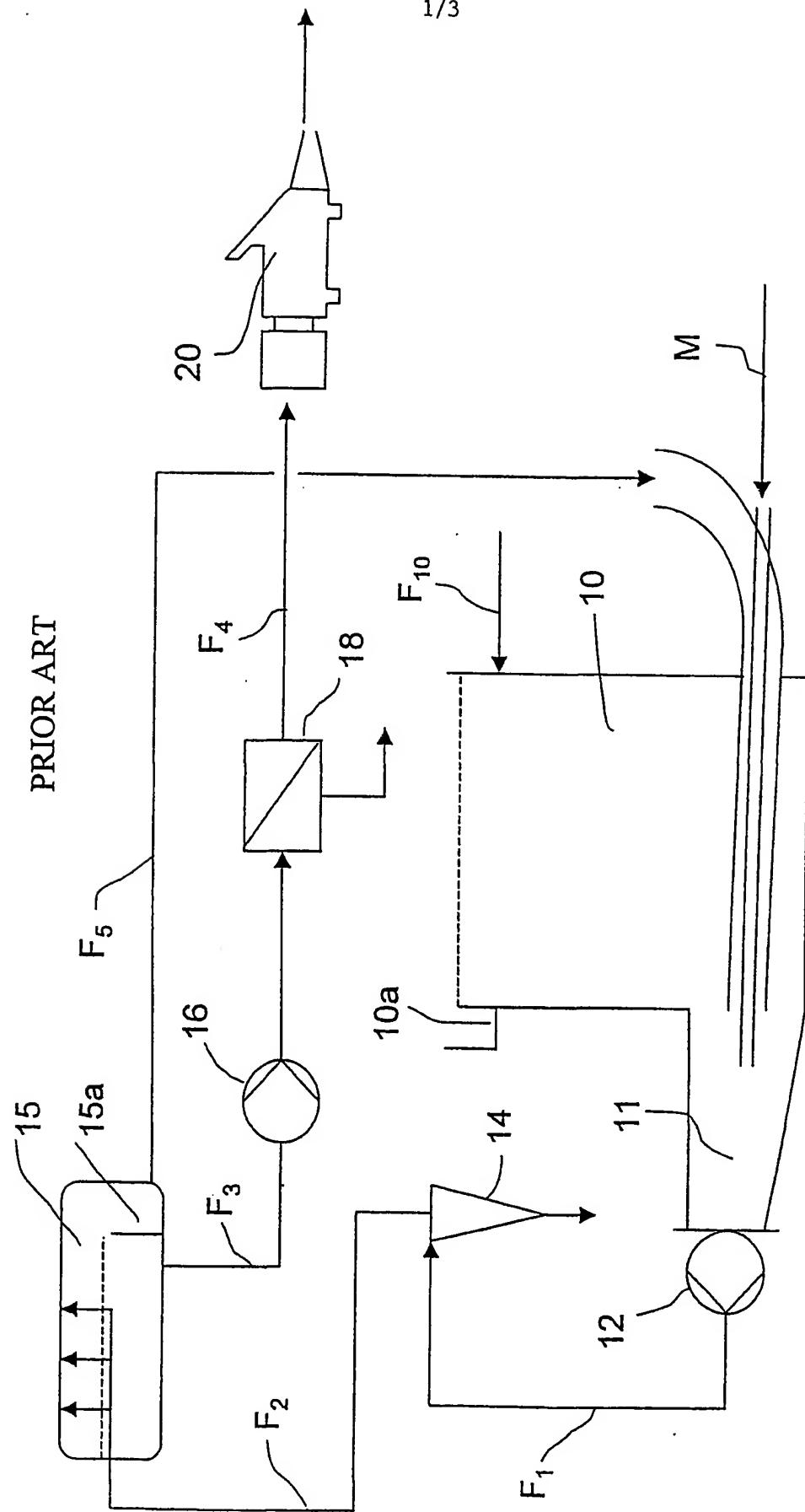
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The process arrangement in accordance with the invention is considerably simpler than the arrangements known in prior art because it does not require any deaeration tank in the main line nor any double dilution of the stock, which have previously been essential for ensuring an even pressure on the suction side of the 10 headbox fan pump.

## Claims

1. A process arrangement in the short circulation of a paper machine comprising devices (10-13) for dilution of thick stock, centrifugal cleaners (14), and a headbox fan pump (16), as well as a pipe system connecting these, and in which there is a direct flow connection from the centrifugal cleaners (14) along a pipeline (30) to the headbox fan pump (16), through which pipeline (30) a centrifugally cleaned stock flow ( $F_6$ ) is passed direct to the headbox fan pump (16) without any deaeration or dilution stages in between, characterized in that a secondary line (32) is connected to said pipeline (30) for passing through it part of the centrifugally cleaned stock flow as a return flow ( $F_7$ ) back to the thick stock dilution devices (10-13), by which arrangement it is ensured that the pressure on the suction side of the fan pump (16) remains substantially constant.
- 15 2. A process arrangement as claimed in claim 1, characterized in that the thick stock dilution devices comprise a mixing pump (12), an incoming flow (M) of the thick stock, a wire water flow ( $F_{10}$ ) and the return flow ( $F_7$ ) of the centrifugally cleaned stock being passed to a mixing space (11, 13) situated on the suction side of the mixing pump.
- 20 3. A process arrangement as claimed in claim 2, characterized in that the return flow ( $F_7$ ) is passed centrally and parallel to the wire water flow ( $F_{10}$ ) to the suction side of the mixing pump (12).
- 25 4. A process arrangement as claimed in any one of the preceding claims, characterized in that the mixing pump (12) and the headbox fan pump (16) have common pressure control, i.e. feedforward control, to control the operating speed.

5. A process arrangement as claimed in any one of the preceding claims, characterized in that other process flows smaller than that of the main line are connected to the secondary line (32).
- 5 6. A method in the short circulation of a paper machine for keeping the pressure constant on the suction side of a headbox fan pump (16), in which method the stock is diluted to headbox consistency, cleaned by centrifugal cleaners (14) and pumped through a headbox (20) to a wire section of the paper machine, and in which a stock flow ( $F_6$ ) is passed from the accept side of the centrifugal  
10 cleaners (14) direct to the headbox fan pump (16) without any deaeration or dilution stages in between, characterized in that the pressure in a pipeline (30) leading from the centrifugal cleaners (14) to the fan pump (16) is kept substantially constant by passing part of the stock coming from the centrifugal cleaners (14) as a return flow ( $F_7$ ) back to the dilution of the thick stock.

**FIG. 1**

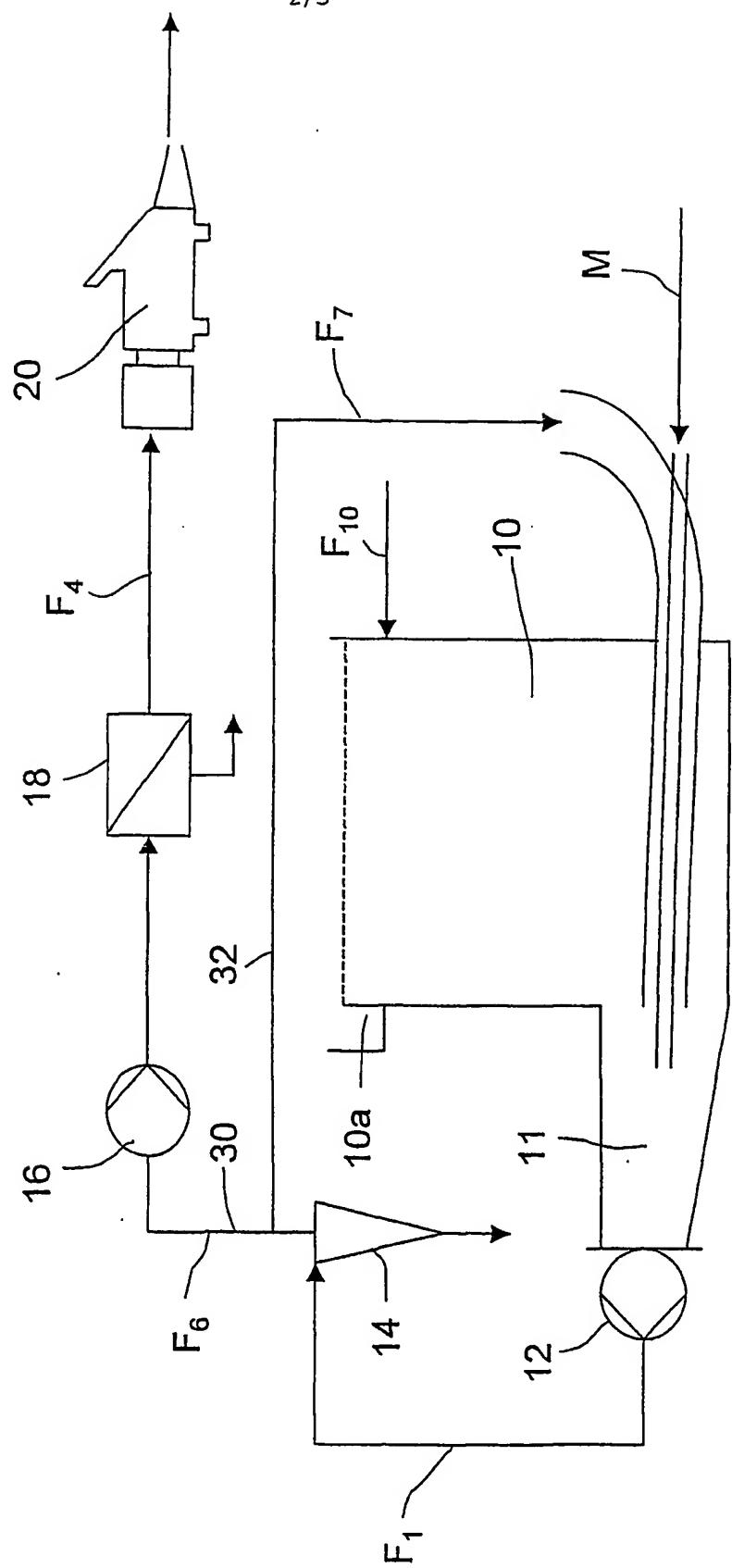


FIG. 2

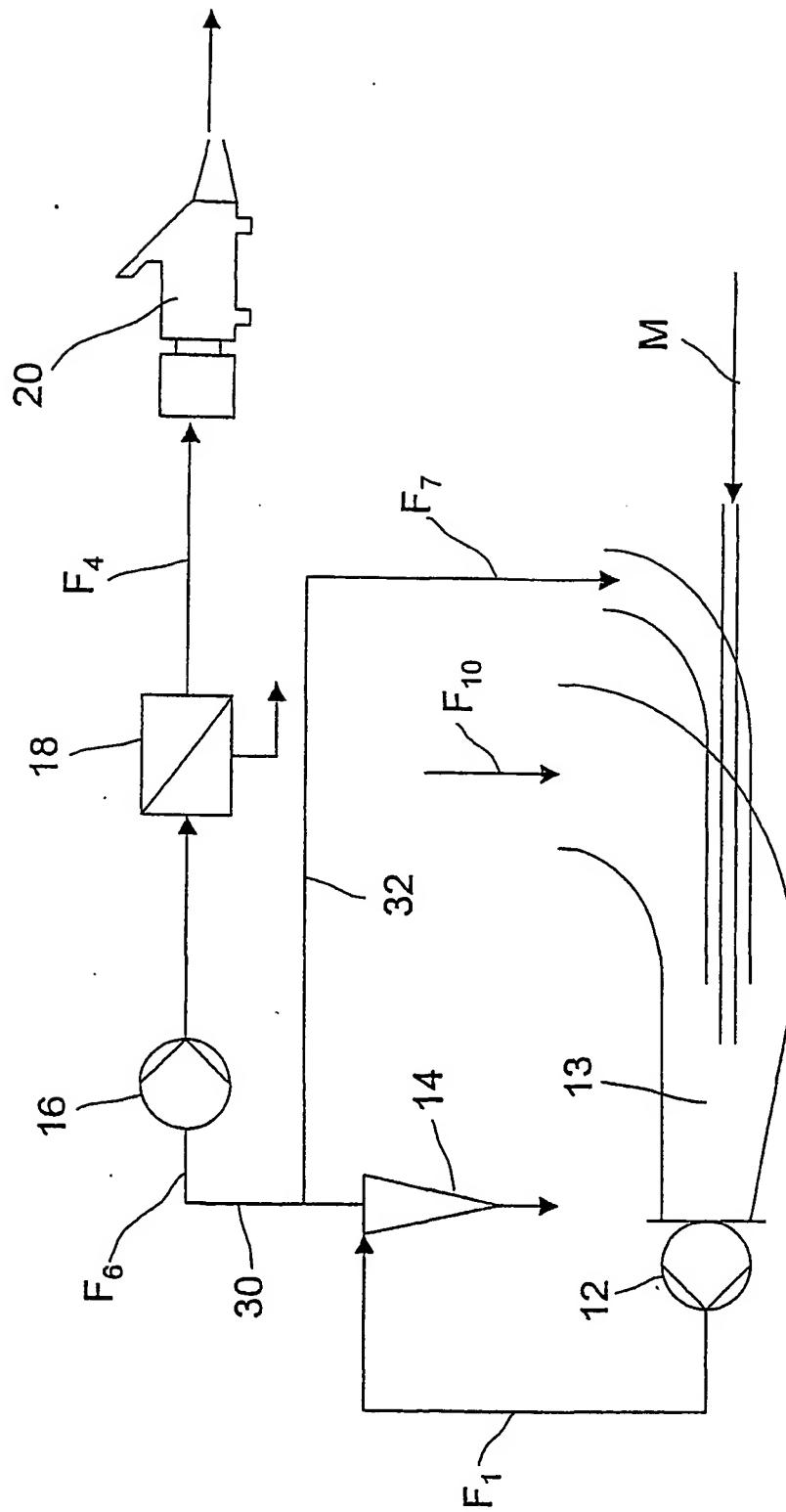


FIG. 3

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 02/00311

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21F 1/00, D21F 1/66

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, PAJ, DIALINDEX:ALLSCIENCE

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9964668 A1 (VALMET CORPORATION), 16 December 1999 (16.12.99), page 13, line 10 - line 19; page 15, line 25 - line 27, figure 4 --- -----	1-6

Further documents are listed in the continuation of Box C.  See patent family annex.

\* Special categories of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

01/05/02

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PCT/FI 02/00311	

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9964668 A1	16/12/99	AU	4619999 A	30/12/99
		BR	9911529 A	20/03/01
		CN	1305549 T	25/07/01
		DE	29909960 U	09/09/99
		EP	1102887 A	30/05/01
		FI	103676 B	00/00/00
		FI	981327 D	00/00/00
		US	6267845 B	31/07/01